ROLE OF DORSAL ON LAY BUCCAL MUCOSAL GRAFT URETHROPLASTY FOR LONG ANTERIOR URETHRAL STRICTURES

Dissertation

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CERTIFICATE

This is to certify that the dissertation titled **"ROLE OF DORSAL ON LAY BUCCAL MUCOSAL GRAFT URETHRO-PLASTY FOR LONG ANTERIOR URETHRAL STRICTURES"** of **Dr. C. PONRAJ** in partial fulfillment of the requirements for M.Ch. Branch – IV (Genitourinary Surgery) Examination of the Tamilnadu Dr. M.G.R. Medical University to be held in February 2006. The period of study was from August 2003 – September 2005 .

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DECLARATION

I, **Dr. C. PONRAJ** solemnly declare that dissertation titled, **"ROLE OF DORSAL ON LAY BUCCAL MUCOSAL GRAFT URETHRO-PLASTY FOR LONG ANTERIOR URETHRAL STRICTURES"** is a bonafide work done by me at Govt. Stanley Medical College & Hospital during from August 2003 – September 2005 under the guidance and supervision of my Unit Chief **Prof. V. DHANAPAL, M.S., M.Ch. (Urology)** Professor and Head of the Department of Urology.

The dissertation is submitted to Tamilnadu, Dr. M.G.R. Medical University, towards partial fulfillment of requirement for the award of **M.Ch. Degree (Branch – IV) in Genitourinary Surgery three years course.**

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CONTENTS

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INTRODUCTION

The long-term results of internal urethrotomy are poor; either requiring repeated dilatation or repeated urethrotomies. Conventional staged urethroplasty does not produce consistent results. The use of flaps or grafts is mandatory in patients with longer and complex strictures.

On lay graft is an recent addition to the armamentarium. On lay graft is done either dorsally or ventrally. Various tissues like penile skin, posterior auricular skin, bladder mucosa and buccal mucosa are used.

Since 1995-96 Barbagli described a new dorsal on lay graft urethroplasty. It has been greeted with fair amount of enthusiasm throughout the world. Success rate of this procedure has been 92-95% for a period of 19 to 36 months.

We have attempted to extend the use of the procedure for long anterior urethral strictures including pan-urethral strictures using buccal mucosal graft.

HISTORY

Suprechko has first described buccal mucosal grafts in 1886. Humby is credited with the first use of buccal mucosa for urethral reconstruction when in 1941 he reported a series of 1-stage hypospadias repair. Before widespread antibiotic use results were poor. A resurgence of the technique occurred in the late 1980s when Duckett reported using the buccal mucosal graft in an epispadias repair and subsequently, complex hypospadias revisions.Barbagli proposed the dorsal placement of buccal mucosal grafts and noted decreased sacculations or diverticulum formation, which marked the revival of free graft urethroplasty.

AIM OF THE STUDY

- To evaluate the efficacy of dorsal on lay buccal mucosal graft urethroplasty in treating long anterior urethral strictures.

MATERIALS AND METHODS

It is a prospective study from August 2003 to September 2005. A total of 13 patients were enrolled in the study.

INCLUSION CRITERIA:

1 .Strictures > 2.5cm in length (Long anterior urethral strictures).

2. Patients requiring repeated internal urethrotomy or dilatations.

EXCLUSION CRITERIA:

1. Periurethral phlegmon
2. Urethrocutaneous fistula
3. Associated with chronic renal failure
4. Scarred perineum.

The preoperative workup included careful general physical examination, palpation of the anterior urethra for any mass; glans penis inspected for signs of urethral meatal stenosis or balanitis xerotica obliterans. The perineum was inspected and examined for the presence of fistulas or periurethral inflammation. Dental surgeon's opinion was obtained regarding the hygiene of the oral cavity and to rule out any buccal mucosal pathology.

The preoperative variables included in our study are age of the patient, duration and etiology of the stricture disease, preoperative uroflowmetry. History of previous urological intervention. Stricture length as per preoperative retrograde urethrogram and intraoperative assessment..

Under nasotracheal intubation, two teams were operating simultaneously in the oral cavity and the perineum. Cystoscopy was done and stricture was intubated with a ureteric catheter in all but one patient in whom visual incision of the stricture extending 1 cm into normal urethra was done. Perineum was explored with midline perineal incision, which was bifurcated posteriorly to improve the accesss. Bulbar urethra was circumferentially mobilized after separating the bulbospongiosus muscle. Strictured urethra and approximately 1 cm of normal urethra was mobilized proximally and distally. In case of pan urethral stricture penis was invaginated and the urethra was separated from the corpus cavernosum up to the meatus. The urethra is rotated 180^{o} and stricture was incised in the 12'o clock position commencing at the distal end of the stricture and proceeding proximally till you get a healthy urethra admitting 24 – 26 fr. bougie without difficulty. At this point length of stricture and surrounding spongiofibrosis assessed. If the dense stricture portion is 1-2 cm with extensive spongiofibrosis

proximally or distally, that portion is excised. The urethral ends were spatulated dorsally and the ventral ends were anastamosed with 4-0 vicryl, forming the floor strip, leaving a diamond shaped defect dorsally. In case patients who have undergone visual incision of the stricture, stricture is already opened and no need to incise urethra after mobilizing it. The length of the stricture measured.

In the same time the oral surgical team harvests the buccal mucosal graft. The parotid duct was identified and desired buccal mucosal graft was outlined and margins infiltrated with submucosal injection of 1: 100,000 lignocaine in adrenaline. The graft was harvested minimizing fat in the undersurface while avoiding dissection into the muscle and going close to the gums. Donor site resutured. Depending on the length of stricture buccal mucosal graft was harvested from one or both cheeks. The graft was defatted and fenestrated. The graft was secured to the cavernosa by interrupted Vicryl sutures. Quilting sutures were placed through the graft into the underlying corporal surface along the length of the graft until the entire graft was secured.

The right mucosal margin of the opened urethra is sutured to the right side of the patch graft, splaying open the strictured tract to new roof, which is the spread fixed graft. The urethra is rotated back to its original position. The left side of the graft is sutured to the left side of

the patch graft and to the corporal bodies. The grafted area is covered entirely by the urethral plate. Bulbospongiosus muscle is reapproximated. Corrugated drain kept. An indwelling 16 fr. Foley catheter is left in place.

In one of the patients Asopa's technique was followed. That is bulbar urethra approached through midline perineal incision and without dissecting the bulbospongiosus muscle bulbar urethra was opened ventrally and incised dorsally at the 12'o clock position and sharply dissected from the tunica albugenia of the corporal bodies. Buccal mucosa harvested from the cheek was fixed to the dorsal urethral defect and quilting sutures were taken through the mucosa and the corporal bodies. 16 fr. urethral Foley kept and the ventral urethrotomy closed. Drain kept and wound closed in layers.

In cases with associated meatal stenosis it was addressed by dorsal on lay buccal mucosal graft with Blandy's flap meatoplasty or ventral meatotomy.

The decision of which procedure to perform and length of buccal mucosal graft needed was partially based on the length and appearance of the stricture on preoperative retrograde urethrography, but

predominantly on the intraoperative findings of stricture length as well as the appearance of the mucosa and spongy tissue.

Patient was started on oral fluids on 1st postoperative day with a help of sucker and semisolid diet on day2 and normal diet then on. The patients underwent pericatheter study on 21st postoperative day and catheter was kept for one more week if it demonstrated leak. Patients asked to have a follow-up visit at 3,6,12 months and yearly there after. They were evaluated with uroflowmetry and AUG.

Success was defined as patient not needing any form of urethral instrumentation. Satisfactory result was defined as patient who needed urethral manipulation once. Failure was defined as patient who needs regular urethral dilatation by urologist or revision of urethroplasty or self urethral dilatation.

RESULTS AND DISCUSSION:

The patients belonged to the age group of 20 to 60 years. Most of them were in the age group of 30 to50 years (76.92%).

TABLE NO 1

AGE GROUP

Age group (years)	No. Of patients
20 – 30	2
31 - 40	4
41 –50	6
51 – 60	1

The one patient whose age was more than 50years, to be precise 52 years was thoroughly evaluated for systemic diseases like diabetes mellitus, hypertension, cardiac or renal failure, intercurrent illness and benign prostatic hyperplasia

Majority of the patients, the stricture was caused due to BXO (61.54%). Post inflammatory stricture was the next common cause (30.77%). One patient had ischemic stricture following vasicolithotripsy and bladder neck incision.

TABLE NO 2

ETIOLOGY OF STRICTURE

Etiology of stricture	No. Of cases
Balanitis xerotica obliterans	7
Post inflammatory	5
Post instrumentation	1

Three patients have already undergone visual internal urethrotomy 2 – 4 times each. Two patients were not able to cope up with self-urethral dilatation program. One patient was undergoing urethral dilatation by the urologist. Six patients have been circumcised. Initially in our study buccal mucosal graft urethroplasty was offered to patients who has failed in traditional form of urethral stricture management like internal urethrotomy and urethral dilatation. As our experience accumulated it was offered to urethral stricture disease patients in the first instance. Six patients were on suprapubic urinary diversion for a period of 3 months to 2 years. The patients have been suffering from stricture disease for a period of 1 month to 15 years.

Radiologicaly stricture was assessed with retrograde urethrogram. They were classified into medium length strictures (2-6 cm) and long segment strictures (> 6 cms).

TABLE NO 3

LENGTH OF THE STRICTURE AND MEATAL STATUS

Length of stricture	No. Of patients	External urethral meatus
2-6 cms	4	Normal
6 – 9 cms	1	Normal
>10 cms	8	7 meatal stenosis

Since most of the stricture disease was due to balanitis xerotica obliterans the number of longer strictures was of high proportion. Preoperative stricture length was increased at least by 2 cm from the radiological length assessed by retrograde urethrogram. All the seven strictures due to balanitis xerotica obliterans were associated with meatal stenosis. The maximum length of stricture encountered was 14 cms.

TABLE NO 4

PREOPERATIVE UROFLOWMETRY

Classification	Peak flow rate	Average flow rate	Voided volume	Not able to void on SPC
Medium length stricture	7.6 to 11.2 ml/sec	3.2 to 6.3 ml/sec	258 to 512 ml	Nil
Long stricture	5 .2ml to 6 ml/sec	2.4 to 3.2 ml/sec	130 to 180 ml	7 patients

The preoperative uroflowmetry was performed in patients who were able to void and not on suprapubic cystostomy.

TABLE NO.5

OPERATIVE PROCEDURES

Classification	Procedure	No. of grafts used	No. of patients.
Medium length stricture	Dorsal on lay graft urethroplasty.	1	1
	Augmented roof top anastamotic urethroplasty	1	1
	Ventral urethrotomy and dorsal BMG onlay urethroplasty (Asopa's Technique).	1	1
	Visual incision of stricture and dorsal BMG onlay urethroplasty.	1	1
Long stricture	Barbagli's procedures	2	7
	BMG sutured to urethra first.	2	2

The medium length strictures had uniform narrowing of the urethra for a fixed length in the bulbar urethra. In these patients Barbaglie type of urethroplasty was done in one of the patients. In one patient Asopa's type of urethroplasty done. 0ne patient under went initial endoscopic incision of the stricture, then the urethra was

mobilized perinealy and dorsal on lay buccal mucosal graft urethroplasty was done. In one patient augmented roof top anastamotic urethroplasty was done. The long strictures two buccal mucosal grafts of size 6-7cm/1.5 cm each were harvested from both cheeks. In two patients BMG was first sutured to urethral edges and then fixed to cavernosa in the sides.

The meatus was addressed by dorsal on lay of buccal mucosa on the roof till the tip of the meatus alone in one patient. Blandy's flap meatoplasty and dorsal on lay buccal mucosal graft till the tip of the meatus in two patients. Ventral meatotomy and dorsal on lay buccal mucosal graft till the tip of the meatus in four patients.

The oral swelling and pain subsided on 3rd postoperative day so as to allow normal diet in twelve patients. In one patient the swelling took five days to subside.

The pericatheter study was performed in twelve patients. In one patient with medium length bulbar urethral stricture who had 16fr. silicon Foley, Foley got extruded due to balloon failure.

TABLE NO.7

PERICATHETER STUDY

Classification	No. of pericatheter studies	No. of no leaks & Catheter removal on 21st POD	No. of leaks & catheter removal on 28th POD
Medium length strictures	3	3	0
Long strictures	9	5	4

The above table clearly shows that of four short and medium length stricture one medium length stricture could not undergo pericatheter study for reasons mentioned above. All the three patients had no leak and had their catheter removed on the 21st postoperative day.

In the group of patients with long strictures 55.56% of them had no leak and had their catheter removed on 21st postoperative day, 44.44% of patients had leak and had their catheter removed on 28th post operative day. The high incidence of leak in pericatheter study in patients with long strictures may be due to the extensive dissection or poor vascularity associated with panurethral strictures.

TABLE NO.8
FOLLOW UP DETAILS

Sl No	Patient Name	Age (Years)	Length of stricture (Cms)	Cause	Uroflowmetry				
					Parameters	Preoperative	Immediate post operative	At 3 months	At 6 months follow up
1	Jeganthan	43	12	BXO	Peak flow rate Avg. flow rate Voided volume.	SPC	29ml/sec 16 ml/sec 256 ml	8 ml/sec 4 ml/sec 212 ml visual dilatation started on self urethral dilatation	16 ml/sec 12 ml/sec 180 ml self urethral dilatation
2	Kanagaraj	33	6	Post Inflammatory	Peak flow rate Avg. flow rate Voided volume.	11.2 ml/sec 6.3 ml/sec 251 ml	32 ml/sec 22 ml/sec 325 ml	28 ml/sec 18 ml/sec 312 ml	20 ml/sec 14 ml/sec 420 ml
3	Ravichandran	33	2.5	Post Inflammatory	Peak flow rate Avg. flow rate Voided volume.	7.6 ml/sec 1.2 ml/sec 124 ml	38 ml/sec 23.2 ml/sec 320 ml	28 ml/sec 20 ml/sec 312	26 ml/sec 18.2 ml/sec 314 ml
4	Munusamy	50	5	Post Instrument tation	Peak flow rate Avg. flow rate Voided vol.	2 ml/ sec 1.5 ml/sec 152 ml	26 ml/sec 18 ml/sec 243 ml	20 ml/sec 16.2ml/sec 242 ml	18 ml/sec 13 ml/sec 324 ml

5	Kanniyappan	37	14	Post Inflammatory	Peak flow rate Avg. flow rate Voided volume.	5.3 ml/sec 3.2 ml/sec 124 ml	24 ml/sec 18.2 ml/sec 212 ml	20 ml/sec 14.3 ml/sec 220 ml	18 ml/sec 12 ml/sec 180 ml
6	Tamilselvan	22	3.5	Post Inflammatory	Peak flow rate Avg. flow rate Voided volume.	7.6 ml/sec 6.0 ml/sec 541.2 ml	26.2 ml/sec 22 ml/sec 312 ml	24 ml/sec 18 ml/sec 298 ml	20ml/sec 16 ml/sec 264 ml
7	Chinnasamy	52	14	BXO	Peak flow rate Avg. flow rate Voided volume.	SPC	24.2 ml/sec 20 ml/sec 312 ml	14 ml/sec 8 ml/sec 329 ml had restricture at 5 months visual dilatation	34 ml/sec 12 ml/sec 364 ml
8	Manavalan	49	12	BXO	Peak flow rate Avg. flow rate Voided volume.	5 ml/sec 3 ml/sec 180 ml	32 ml/sec 22 ml/sec 280 ml	18ml/sec 10 ml/sec 320 ml	11.2 ml/sec 6.0 ml/sec 272 ml visual dilatation

9	Shanmugam	32	14	BXO	Peak flow rate Avg. flow rate Voided volume.	SPC	29 ml/sec 18 ml/sec 325 ml	22 ml/sec 16 ml/sec 330ml	17 ml/sec 11 ml/sec 327 ml
10	Parvatham	26	14	BXO	Peak flow rate Avg. flow rate Voided volume.	SPC	23 ml/sec 12 ml/sec 314 ml	16 ml/sec 12 ml/sec 314 ml	13 ml/sec 11 ml/sec 652 ml submeatal catch dilated
11	Harikrishnan	47	8.5	Post inflammatory	Peak flow rate Avg. flow rate Voided volume.	SPC	41 ml/sec 22 ml/sec 309 ml	23 ml/sec 16 ml/sec 592 ml	15 ml/sec 11 ml/sec 607 ml
12	Ramu	40	10	BXO	Peak flow rate Avg. flow rate Voided volume.	SPC	19 ml/sec 13 ml/sec 234 ml	18 ml/sec 14 ml/sec 243 ml	
13	Munusamy	50	12	BXO	Peak flow rate Avg. flow rate Voided volume.	4 ml/sec 3 ml/sec 142 ml	36 ml/sec 24 ml/sec 260 ml		

Immediate uroflowmetry is done on first day of catheter removal. Peak flow rate was in the range of 19 ml/sec to 41ml/sec with an average peak flow rate of 31.4 ml/sec

The follow up period ranged from 3 months to eighteen months. Prolonged pericatheter discharge was present in four of the panurethral stricture patients. One patient developed urethrocutaneous fistula that healed with prolonged catheter drainage. Two patients developed epididymo orchitis which was managed with good urethral nursing and antibiotics. One patient had transient terminal haematuria settled with conservative line of treatment. One patient had mild restriction in opening the mouth. Two patients had donor site numbness which settled on follow up.

The medium length stricture patients(2,3,4,6) had sustained good flow rate at 12 months of follow up with average peak flow rate of 19 ml/sec, average mean flow rate of 14 ml/sec. The first patient who underwent substitution for pan urethral stricture had recurrent stricture at 3 months of follow up. Visual dilatation showed recurrent narrowing in the proximal bulbar region. He was advised self urethral dilatation and he is on regular follow up. Of the other three pan urethral strictures who had recurrence one had sub meatal stenosis and he was advised self

meatal dilatation and two others had bulbar urethral narrowing are having durable results with single visual dilatation of urethra.

Of the two bulbar urethral narrowing patient one had no leak in the pericatheter study. The follow up urethrogram in that patient showed evidence of graft loss. The patient underwent visual dilatation of the strictured segment and advised periodic urethral dilatation (once in a month). Patient reviewed after 2 months with a peak flow rate of 14 ml/sec and average flow rate of 11ml/sec. All the four patients were of the age group of 36 to 52 years.

TABLE NO.9

COMPARISON OF PANURETHRAL STRICTURE

Variables	**Anant kumar et al.,**	**N.P.Gupta et al.,**	**Ducket et al.,**	**Our study**
No. of patients	**25**	**12**	**2**	**9**
Meatus and penobulbar stricture	**4**	**8**	**2**	**2**
Panurethral stricture	**21**	**4**	**0**	**7**
Failure	**3**	**1**	**0**	**1**
Followup period	**3-52 months**	**10-16 months**	**6-84 months**	**3-18 months**

In Ananth Kumar et al., have used circum-coronal incision for penile urethral strictures. In N.P. Gupta's group they have used Asopa's technique of ventral urethrotomy and dorsal on lay technique. Since substitution urethroplasty is prone for detoriation over period of time longer follow up is needed before coming to solid conclusions.

TABLE NO.10

COMPARISON OF MEDIUM LENGTH BULBAR URETHRAL STRICTURES

Variables	Vito et al	Barbagli et al	Christopher et al	Our series
No. of cases	23	45 skin graft	25	4
Success	23	33	24	4
Failure	0	12	1	0
Peri cath study leak	2	Not reported	Not reported	0
Folowup months	3-50 months	41-100 months	10-37 months	11-13 months

In the Barbagli series they have used skin as the graft material. Of the failed cases 50% underwent perineal urethrostomy. In the Vito group they have tried ventral on lay in 7 patients. They had recurrence in one of those patients. Longer follow up is needed to substantiate our results.

SALIENT FEATURES

1. Long anterior urethral stricture predominantly occurs in the age group of 30 to 40 years.

2. Balanitis xerotica obliterans is the commonest cause of stricture we have encountered.

3. Meatal stenosis was present in 77.78% of the long anterior urethral stricture group.

4. Buccal mucosal donor site heals with minimum complications.

5. Leak in pericatheter study and age did not adversely affect the end result.

6. Restricture occurred in the submeatal and proximal anastamotic site with the intervening graft healthy.

7. Of the 22 grafts used 0ne graft loss has occurred.

8. Graft loss had a durable result after visual dilatation for two months and still on follow up.

9. Medium length bulbar urethral strictures had 100% result irrespective of the technique used at 1 year of follow up.

10. Urethrocutaneous fistulas requiring surgical correction has not occurred in our series even in panurethral strictures

11. .Long urethral strictures had a successful treatment in 5 out of 9 patients(55.56%) ,satisfactory result in 3 out of 9 patients(33.33%) and failiure in 1 patient who needed self urethral dilatation(11.11%).

REVIEW OF LITERATURE

ANATOMY

Male urethra is divided into posterior urethra and anterior urethra. The posterior urethra includes prostatic urethra and membranous urethra. The anterior urethra includes the fossa navicularis, penile urethra, and bulbar urethra. Posterior urethra comprises of prostatic urethra and membranous urethra.

The corpus spongiosum soft tissue surrounds the anterior urethraThe corpus spongiosum, lies in the ventral groove between the two corpora cavernosa. The tunica albuginea (adventitia) of the corpus spongiosum is thinner and contains less erectile tissue than the tunica of the corpora cavernosa. The urethra traverses the length of the penis within the corpus spongiosum. At its distal end, the corpus spongiosum expands to form the glans penis, a broad cap of erectile tissue covering the tips of the corpora cavernosa.

Buck's fascia is the tough, elastic layer immediately adjacent to the tunica albuginea. On the superior aspect of the corpora cavernosa, the deep dorsal vein, paired dorsal arteries, and multiple branches of the dorsal nerves are contained within the envelope of Buck's fascia. In the midline groove on the underside of the corpora cavernosa, Buck's fascia

splits to surround the corpus spongiosum. Consolidations of the fascia, lateral to the corpus spongiosum, attach it to the tunica albuginea of the corpora cavernosa. Attached distally to the undersurface of the glans penis at the corona, Buck's fascia extends into the perineum, enclosing each crus of the corpora cavernosa and the bulb of the corpus spongiosum and firmly fixing these structures to the pubis, ischium, and the inferior fascia of the perineal membrane (urogenital diaphragm).

Anterior urethra extends from the inferior fascia of urogenital diaphragm to the external meatus of the penis. For better understanding of discussion about reconstruction of urethra t is subdivided into three regions. These regions are

The fossa navicularis is contained with the spongy erectile tissue of glans penis and it terminates at the junction of the urethral epithelium with the skin of the glans. This portion of urethra is lined with stratified squamous epithelium.

1. The penile or pendular urethra lies distal to the investment of the ischiocavernosus musculature but it is invested by the corpus spongiosum. The pendulous urethra is lined with simple squamous epithelium.

2. The bulbous urethra is covered by the midline fusion of the ischiocavernosus musculature and is invested by the bulbospongiosus and corpus spongiosum. It becomes larger and lies closer to the dorsal aspect of the corpus spongiosum, exiting at its dorsal surface before the posterior attachment of the bulbospongiosus to the perineal body. The bulbous urethra is lined with squamous epithelium which changes to transitional epithelium found in the membranous urethra as it swings upwards.

HISTOLOGY

The wall of urethra is formed in three layers.

1. Muscular coat

The muscular coat of the prostatic and membranous urethra is the downward continuation of the detrusor muscle of the urinary bladder. Therefore it is especially innervated by the sympathetic nerve fibres. The sphincter urethra is formed by the striated muscle which surrounds the membranous urethra.

2. Mucosal coat

The mucosal coat is composed proximally of transitional epithelium continuous with that of the bladder. This cell type terminates in the verumontanum, just distal to the opening of the ejaculatory ducts. Distally a mixture of stratified columnar epithelium and pseudostratified

epithelium with mucous glands can be found. The mucous membrane of the penile urethra is characterized by frequent recesses associated with the tubular mucous glands of Littre, particularly in the dorsal part of the urethra. Distally in the penile urethra, the mucosa becomes stratified squamous in character.

3. Submucosal layer

The submucous layer extends throughout the length of the urethra. It has a rich vascular and erectile network.

ARTERIAL SYSTEM

The blood supply to the anterior urethra is derived from the common penile artery, which is a continuation of the internal pudendal artery after it gives off its perineal branch From that point, the artery is termed the common penile artery and travels along the medial margin of the inferior pubic ramus. As it nears the urethral bulb, the artery divides into its three terminal branches, as follows:

1. The bulbourethral artery is a short artery or arteries of relatively large caliber that pierce Buck's fascia to enter the bulbospongiosus. These arteries are oriented almost parallel to the path of the membranous urethra.

2. The dorsal artery along its course, it gives off 3 to 10 circumflex branches (the circumflex cavernosal arteries) that accompany the circumflex veins around the lateral surface of the corpora cavernosa. Its terminal branches arborize in the glans penis. Proximally, the circumflex arteries are also a part of the blood supply of the corpus spongiosum.
3. Tiny branches from deep arteries of penis.

Superficial Perineal Space

In males, the superficial perineal space contains the continuation of the corpora cavernosa, the proximal part of the corpus spongiosum and urethra, the muscles associated with them, and the branches of the internal pudendal vessels and pudendal nerves.

The ischiocavernous muscles cover the crura of the corpora cavernosa. They attach to the inner surfaces of the ischium and ischial tuberosities on each side and insert at the midline into Buck's fascia, surrounding the crura at their junction below the arcuate ligament of the penis. The bulbospongiosus muscles are located in the midline of the perineum. They are attached to the perineal body posteriorly and to each other in the midline, as they encompass the bulbospongiosus and crura of the corpora cavernosa at the base of the penis. These muscles are

confluent with the ischiocavernous muscles laterally, and at their insertion into Buck's fascia, covering the dorsal vessels and nerves at the base of the penis.

STRICTURE DISEASE

Etiology

Basically the strictures involving the anterior urethra are caused by

1. Inflammatory disease of corpus spongiosum like Balanitis Xerotica Obliterans(BXO), post gonococcal strictures.
2. Ischemia - common in patients after urological endoscopic procedures, patients with cardiovascular disease.
3. Traumatic scarring after blunt perineal trauma.
4. Hypospadias failure.
5. Congenital anomalies of the mucosal membrane, usually in the bulbar urethra with the corpus spongiosum not involved.

Pathogenesis

However simple the pathology might appear to be, the etiology of many strictures is unknown. When most strictures were gonococcal in origin it was nonetheless clear that a stricture did not necessarily follow an attack of gonorrhoea, and when it did the time lag could be considerable. Thus an episode of infection or trauma is not necessarily a direct cause of a stricture. In an interesting review of the anatomy of urethral stricture disease, Chambers et al. noted that the first identifiable change in urethral stricture disease was a change in the nature of the urethral epithelium from a pseudo-stratified columnar epithelium to a columnar epithelium that lacks the waterproofing quality of the pseudo-stratified variant. Consequently, they hypothesized that urine could extravasate and lead to fibrosis.

Partial loss of urethral lining is also important factor predisposing to stricture formation. Since it exposes spongiosal vascular spaces to the passage of urine and this results in superficial spongiothrombosis which progresses to a layer of spongoifibrosis. The loss any portion of circumference of the epithelial lining generally results in commensurate narrowing of the lumen during healing because the margins of residual epithelium are approximated by the natural urethral closure pressure so that unepithelialized defects forms clefts that

tend to heal by cross adhesion and epithelial over bridging. However intermittent passage of urine opens these clefts, and this repeated separation and re-exposure of the underlying vascular spongy tissue spaces – combined with relatively slow uroepithelial proliferation – leads to gradual increase in underlying spongiothrombosis and consequently spongiofibrosis and stricture formation.

Singh and Blandy explained particular association of inflammatory stricture disease with the mid-bulbar and distal penile segments of the urethra on the basis that most urethral glands were at those sites. Thus inflammatory urethral strictures were the consequence of fibrosis beginning initially in the corpus spongiosum, caused either directly from the extravasation of urine through the urethral epithelium or indirectly by involvement of the urethral glands at specific sites, and subsequent extension into the spongiosum. Once initiated, fibrosis within the corpus spongiosum can cause constriction of the urethral lumen and if there is also infection, this can cause micro-abscess formation within the urethral glands, which makes fibrosis worse and may lead to peri-urethral extension of that fibrosis.

Urethra lined by Water proof pseudo stratified columnar epithelium

↓

Leaky columnar epithelium

↓

Extravasation of urine and Spongiofibrosis

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Constriction of urethral lumen

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Micro abscess in urethral glands

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Periurethral extension of inflammation

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More severe stricture

Spongiofibrosis

The surgical significance of established urethral spongiofibrosis is its high predisposition to progress to stricture formation when it is inappropriately used in surgical repair. Thus it is the overall extent of the spongiofibrosis associated with a stricture and not simply the length of stricture of the stricture itself – that should properly determine both the type and extent of a urethral repair required to achieve satisfactory long – term resolution. If the longitudinal extent of a urethral repair is limited only to the length that is actually strictured, as opposed to the length of the spongiofibrotic abnormality, it commonly results in restenosis.

Severe spongiofibosis changes are often palpable and they are generally apparent urethrographically by a scarred reduction in the caliber of the urethral lumen and by the excavation of the ducts of the

glands of Littre and Cowper. Endoscopically spongiofibrotic urethra has a whitish colour – quite distinct from the normal urethra that is pink because the underlying vascular spongy tissue is seen through the translucent covering of the urothelium. However preoperative evaluation even by Sonourethrogram offers only a guideline- the critical extent of the surgically significant spongiofibrotic gray urethral abnormality may not be apparent until it can be accurately determined by direct inspection at the time of operation when the urethra has been opened by an incision extending into truly normal pink urethra proximally and distally – when it is revealed by a well defined thin layer of sub epithelial fibrosis that is clearly distinguishable.

With progressive constriction of the urethral lumen and if outlet obstruction develops, secondary changes may arise in the lower urinary tract, and even the upper urinary tract. One consequence of obstruction is a predisposition to recurrent urinary infection and secondary prostatitis and epididymitis are also common. Upper tract complications are less common now than they were 50 years ago, but are still common in certain areas of the world with less than adequate access to urological care.

The results of dilatation and urethrotomy were recently reviewed by various authors, who concluded that urethrotomy had no advantage

over dilatation in terms of cure rate and that if one urethrotomy or dilatation fails to cure a patient then a second rarely will and a third never does. Furthermore, the only strictures that regularly respond are single short strictures of the bulbar urethra and then only in <60% of cases. Multiple strictures, strictures >1 cm long and strictures in the penile urethra rarely respond. Various methods have been used to improve the results, e.g. using a laser to divide the stricture rather than a cold knife, using a stent to hold the stricture segment and the urethra open, or using self-dilatation in the form of self urethral dilatation to hold the urethra open after an initial urethrotomy. The results of laser urethrotomy suggest that it has no advantage over cold-knife urethrotomy although theoretically the vaporization of a superficial annular intraluminal ring constriction mightwork, where a laser urethrotomy performed in the same way as the cold-knife urethrotomy might not. Intraurethral stents may be effective when spongiofibrosis is not too extensive. When it is, the fibrotic tissue tends to grow through into the lumen of the stent, particularly in traumatic strictures and those with periurethral fibrosis. Moreover, even when successful, there is a significant morbidity with intraurethral stents because the urine pools, causing postvoid dribbling and irritative symptoms, if not frank infection. There is also pooling of semen after intercourse, interfering

with ejaculation and its perception. Some patients have discomfort if not frank pain at the site of a stent. Likewise self-urethral dilatation is not accepted by all patients, who like to have their diseases treated by doctors rather than by themselves. Even those who are prepared to try self-urethral dilatation tend to discontinue subsequent self-urethral dilatation programmes because of difficulties, if only the social inconvenience of the technique. Thus the only curative treatment for most patients with urethral stricture disease is urethroplasty.

Balanitis Xerotica Obliteran

Of the.causating factors for stricture urethra BXO needs special mention. It was first described in 1928, is a form of Lichen Sclerosis. It occurs in up to 1 in 300 men. The cause is not clear. It most commonly occurs in the glans penis and prepuce causing phimosis, with more extensive disease affecting the urethra as far back as the proximal bulbar urethra. The dictum for treatment often taken on major proportions including excision of the entire affected urethra and the use of extra genital tissue (buccal mucosal graft) for reconstruction, so as to prevent recurrent disease in the repaired area. These are morbid procedures fraught with complications and high failure rate up to 71%.

Surgical procedures recommended for anterior urethral stricture according to the length of the stricture is

SURGERY FOR STRICTURE URETHRA

Length of stricture	Type of procedure
1-2cm Bulbar urethral stricture	End to end urethroplasty
2-3 cm	Augmented roof top anastamotic urethroplasty
3-6 cm	Augmented dorsal or ventral on lay graft urethroplasty
>6 cm	Staged urethroplasty.

For strictures more than 2 cms in length substitution urethroplasty is advocated. Substitution urethroplasty involves augmenting or replacing the circumference of the urethra with a patch or tube of a material respectively.

Poor prognostic factors for urethroplasty are

1. Periurethral fibrosis
2. Poor vascular supply
3. Periurethral phlegmon
4. Poor tissue availability
5. Previous instrumentation
6. Long stricture
7. Balanitis Xerotica Obliterans (BXO).

In the presence of risk factors staged urethroplasty is advocated.

Graft take

Graft take occurs in two phases – imbibition and inosculation. And it takes 96 hours. During initial phase that is imbibition, takes about 48 hours and during that phase the graft survives by drinking nutrients from he adjacent graft host bed. During the phase grafts temperature is less than the body temperature. In response to the growth factors produced by the hypoxic vessels in the graft during inosculation, new vessels are produced as buds from arteries, veins and lymph channels in the vascular bed. These new vessels grow through the fibrin matrix that has formed between the graft and graft bed and penetrate the graft to hook up with the vessels in the sub dermal and intradermal plexus, reperfusing the grafted skin. During this phase the temperature of the graft rises to core body temperature. The process of take is influenced by both the nature of the grafted tissue and the conditions of the host bed.

Deepak Dubey et al., have reviewed about their management of BXO single stage or multiple stage procedures. They had the complications of graft loss; stromal revision and glans cleft narrowing in 5 out of 14 of their staged urethroplasty patients. None of their 25 single stage urethroplasty patients had similar problems. Recurrent stricture

was noted in 21.4% of II stage urethroplasty and 12% of single stage urethroplasty patients.

Jean V. Joseph et al., on reviewing their 38 staged urethroplasty patients Patients underwent revision of stageI and 8 underwent revision of stageII of urethroplasty. He has concluded by saying II stage urethroplasty is often converted into multistage procedure. A single patient required three revisions for stage one procedure before he was fit for stage II procedure.

Ezo Palminteri et al., have concluded that stageII urethroplasty involves considerable patient inconvenience and increased risk of morbidity because of multiple anesthetic procedures.

Revisions are common with staged urethroplasty and in approximately 50% of patients a 2-stage procedure will turnout in practice to be 3 stages. Penile urethroplasty is particularly susceptible to revision. It has a restricture rate of 4% at 6 months follow-up in best of hands.

Grafts are placed preferably dorsally in case of anterior urethral stricture disease because

1. Graft is placed over corporal bodies which provides

- Good support and prevents sacullation and pouch formation

- Good vascular bed potentiating graft take.
- Good immobilization of the graft.
- Less chance for graft shrinkage and chordee.
- A potential for roof strip epithelial regeneration according to the principles of Duplay, Davis, Traut, Brown, Weaver & Schulte, Moore and Monseur.

2. Urethrocutaneous fistula can be prevented by adequate duration of indwelling catheter.

3. It preserves residual blood supply of the corpus spongiosum.

4. In case of bulbar urethra it requires less extensive opening of spongy tissue ad urethra is positioned dorsally.

M.T.El-Sherbuny et al., conducted a study in dogs using buccal mucosal graft urethroplasty and found that BMG shrinkage was less than 10%. When compared to full thickness skin graft and bladder mucosal graft buccal mucosal graft had less inflammation, less fibrosis and uniform graft thickness at 3 months after grafting.

Buccal mucosal graft

The uniqueness of buccal mucosa and its histologic and antibacterial properties make it the superior tissue for reconstruction. The unique structure of the buccal mucosa allows it to be an excellent

grafting material. It is 500 micrometer thick and is a nonkeratinized, stratified squamous epithelium consisting of four layers. The stratum basale, or germinative layer of the epithelium. Rests against the basement membrane and provides the progenitor cells for cellular division. The basale is two or three cells thick and and includes melanocytes and antigen presenting Langerhans cells, sensory Merkel cell, and lymphocytes. Its rapid turnover rate with only 25 days required for all layers of buccal mucosal epithelium to be replaced.

The stratum spinosum is the next layer, which provides intercellular bridges that give the buccal mucosa the prickle appearance in light microscopy. The outer two layers (stratum intermedium and superficiale) are difficult to delineate from each other. These cells are however are unique in that they are more firmly attached to each other than are cells of other keratinized tissue, providing excellent barrier protection.

Beneath the basement layer of the epithelial layer is the lamina propria, where collagen and elastin predominate. Elastin fibres are more numerous in the buccal mucosa than in other tissues allowing buccal mucosa to recoil after stretching. The lamina propria further provides long slender papillary invaginations into the epithelia and loose collagen fibres and loops of capillaries from which the epithelium gets its blood

supply. The web like reticular layer of lamina propria holds the vasculature and nerves of the buccal mucosa. Collagen, elastin and ground substance depend on the fibroblasts that also reside in the area.

The line between the submucosa and the lamina propria is difficult to delineate. The submucosa, which is firmly attached to the underlying buccinator muscle, is also rich in collagen and elastin in addition to minor salivary glands and sebaceous glands. A major salivary glands duct (Stensen's duct) from the parotid gland pierces the buccinator muscle opposite the maxillary second molar bilaterally.

The arterial supply to the buccal mucosa originates from the facial artery, the buccal artery and the posterior superior alveolar artery and inferior superior alveolar artery of the external carotid.

Buccal mucosa is an ideal substitute for urethra because

1. It has a thick epithelium rich in elastin, which makes it durable and easy to handle.
2. High amount of type IV collagen content
3. Helps in good graft take.
4. Lamina propria is thin compared to skin and bladder mucosa, which facilitates inosculation and neovascularisation.

5. It has pan laminar plexus – so it can be thinned provided sufficient amount of deep lamina is carried to preserve the physical characteristics.
6. It has high capillary density.
7. The graft carries a wet epithelial surface.
8. Thickness of BMG makes it easy to handle.
9. It is a better substitute in case of BXO.
10. Harvesting of BMG is easy and easy to apply.
11. Large volume is available.
12. It heals without much pain.
13. There is no visible scar or deformity.
14. It is resistant to infection.
15. Graft contracture is <10%.

Inner cheek is the preferred site of buccal mucosal graft harvesting as it gives a broader and more thicker and resistant mucosa.

Bargava et al., have produced tissue engineered buccal mucosal graft from a small buccal mucosal biopsy to produce 1 or 2 2/10 cm patches of tissue engineered buccal mucosal graft in 5-6 weeeks. It closely resembles native oral mucosa and can withstand mechanical stress.

BMGS IN STAGED URETHROPLASTY

There are clear indications for staged urethroplasty particularly where the stricture is complex, lengthy or caused by BXO. Whilst traditionally scrotal skin inlay has been used for two-stage procedures, as it provides a large quantity of easily accessible tissue, it has significant limitations, which include being hair-bearing, undergoing excoriation and hyperkeratosis, leading to graft failure in the wet environment of the urethra and an increased risk of diverticulum formation. With the recognition of the problems associated with scrotal skin, both full and split-thickness skin flaps and grafts derived both from penile and extragenital sites have been used, but penile skin can be limited by the availability of tissue if the patient has been circumcised. Whilst some reports have suggested poor results when extragenital skin is used as a graft others have been more successful. With this in mind Schreiter and Noll described use of meshed split or full-thickness skin grafts for staged urethroplasty; despite having the advantage of not being hairbearing it is subject to graft contraction and exuberance of granulation tissue through the interstices of the mesh. Wessels and McAninch, in a review, described no apparent benefit attributable to the use of flaps over grafts; long-term results were comparable in both groups but nevertheless grafts require less dissection and a shorter

operating time than raising a penile flap. Buccal mucosa offers the advantage of being accustomed to a wet environment, hairless, easy to harvest, resilient to infection, a thick epithelium (making it easy to handle) and a reduced likelihood of pseudo-diverticulum formation even when used ventrally, unlike skin inlay grafts, but it has a thin lamina propria allowing early inosculation. There are two published series where buccal mucosa was used for two-stage urethroplasty in both the groups the graft performed well. About 23% of patients required minor revision after the first stage, with proximal graft stenosis comprising most of these revisions. One patient in each series developed an urethrocutaneous fistula and in contrast to two-staged repairs using skin grafts, none of the patients developed a diverticulum, although the follow-up was short.

BMGS AS A VENTRAL/DORSAL FREE GRAFT

The use of a graft in urethral reconstruction has found renewed interest in the last two decades; traditionally grafts have been placed on the ventral aspect of the urethra because it allows easier access to the urethra and better visualization of the stricture. Penile and nonhirsute extra genital skin have commonly been used for reconstructing the urethra; using skin the common problems faced include those caused by contraction of the graft (especially with split-thickness grafts), an

increased incidence of diverticulum formation and the risk of potential cosmetic deformity at the donor site. Penile skin has been used with long-term success rates of 50–95%. Ventrally placing a graft is likely to be associated with a higher rate of graft failure because of an inadequate graft bed and poor support, leading to diverticulum's formation, which then leads to post void dribbling and ejaculatory dysfunction. Previous experience using skin grafts for strictures in the penile urethra has not been encouraging, largely attributable to a less abundant corpus spongiosum than in the bulbar urethra, and thus a poorer blood supply and hence lower take rates. Barbagli et al., following the concept advocated by Monseur, introduced the dorsally placed graft, and postulated that dorsal placement is advantageous as it allows better mechanical support for the graft with a richer vascular bed for the graft from the underlying corporeal bodies. Whilst there are no randomized controlled trials comparing ventral or dorsal placement of the graft using either skin or buccal mucosa, assessing all publications shows no particular benefits for re-stricture rates. The overall success rate for a ventrally placed buccal mucosa graft is 85% at a mean followup of 36.9 months; this includes the entire population of strictures irrespective of the site. When bulbar strictures alone are considered the success rate is 89%. There were no reports of the development of urethrocutaneous

fistula after a one-stage ventral BMG in the available series, but when skin was used, as a ventral graft fistula formation was common, especially where the graft failed to vascularize. In one of the largest published series, 21% of the patients reported some post void dribble after Surgery but no pseudo-diverticulum formation. The overall success rate with dorsally placed BMGs is 96% with a mean follow-up of 38 months; dorsal onlay using skin gives success rates of 85% in comparison. None of these patients developed any urethrocutaneous fistulae or pseudo-diverticula.

BUCCAL MUCOSA AS A TUBE GRAFT

Tubularized grafts fail largely because of inadequate graft take, as they are not circumferentially surrounded by vascularized tissue. There are three published series where tubularized grafts have used buccal mucosal. In all of these studies 37 of the 43 tubes constructed were to correct either hypospadias or epispadias. Urethrocutaneous fistula developed in six of 43 patients and there were five who developed meatal stenosis. Recently Barbagli et al. described an onestage circumferential urethroplasty where, in complex cases, the diseased urethra is excised and replaced with buccal mucosa placed on a circumferential spongioplasty, thereby providing good fixation to a robust well vascularized underlying tissue. Within a mean follow-up of

38 months none of the five patients developed a stricture. Therefore a tube graft using the spongioplasty technique may be more applicable to the bulbar than the penile urethra; unless there is adequate surrounding spongy tissue it is unlikely that there will be adequate graft take, which will inevitably lead to complications.

COMPLICATIONS

Although serious complications resulting from harvesting a BMG are infrequent, until recently donor-site complications were not reported. Possible adverse effects of harvesting buccal mucosa include intraoperative haemorrhage, postoperative infection, pain, swelling, damage to the parotid duct, limitation of oral opening and loss or altered sensation of the cheek or lower lip through nerve damage. Damage to the surrounding structures can be avoided by careful marking of the cheek mucosa before harvesting; it is recommended that the dissection should be at least 1 cm from the opening of the parotid duct and care should also be taken during suturing of the wound. Harvesting mucosa from the cheek carries less morbidity than from the inside of the lips. Paraesthesia after harvesting a BMG is the commonest complication but is transient in most patients. In a recent study Dublin and Stewart reported that 57% of patients year. Caldamone et al.reported two patients who developed scar contractures; Dubey et al. reported bleeding

in one patient requiring surgical intervention, and in both these series both the cheek and lower lip were used for harvesting the graft.

Buccal mucosa has proved to be a useful alternative to skin. It is easy to harvest and to handle, is resilient to infections and accustomed to a wet environment. The BMG has been used successfully for treating all types of strictures, with medium-term outcomes comparable to using skin as a substitute, but with less donor site morbidity and fewer complications. Because of its inherent advantages buccal mucosa has become the recommended source for tissue substitution during urethral reconstruction and longer-term results are awaited with interest.

N.P.Gupta etal., reviewed their experience in treating 12 patients with a long anterior urethral stricture had the anterior urethra reconstructed, using a one stage urethroplasty with a dorsal on lay buccal mucosal graft through a ventral sagittal urethrotomy. The urethra was approached via a small perineal incision irrespective of the site and length of the stricture. The penis was everted through the perineal wound. No urethral dissection was used on laterally or dorsally, so as not to jeopardize the blood supply. The mean (range) length of the stricture was 5 (3–16) cm and the follow-up 12 (10–16) months. They have used micturating cystourethrogram at 21st post operative day, and in the presence of leak they have retained the catheter for two more

weeks for one patient. The results were good in 11 of the 12 patients. One patient developed a stricture at the proximal anastomotic site and required optical internal urethrotomy. Dorsal buccal mucosal graft urethroplasty via a minimal access perineal approach is a simple technique with a good surgical outcome; it does not require urethral dissection and mobilization and hence preserves the blood supply.

Anant Kumar et al., have reviewed 39 patients who underwent buccal mucosal urethroplasty for BXO related anterior urethral strictures. The 25 patients with a salvageable urethral plate (group 1) were treated with 1-stage dorsal onlay urethroplasty using a cosmetic incision. The 14 patients with a severely scarred urethral plate, focally dense segments or active infection (group 2) underwent 2-stage urethroplasty. At a mean follow-up of 32.5 months (range 3 to 52) 3 patients (12%) in group 1 had recurrent stricture, of which 2 and 1 were treated with optical urethrotomy and urethral dilation, respectively. All patients had a normal slit-like meatus and none had chordee or erectile dysfunction. Four group 2 patients (28.6%) required stomal revision and 2 had glans cleft narrowing after stage 1 urethroplasty. Following stage 2, 3 patients had recurrent stricture, of whom 2 were treated with optical urethrotomy and 1 underwent repeat urethroplasty. They have concluded that in BXO. related strictures with a viable urethral plate 1-stage dorsal

onlay buccal mucosal urethroplasty provides excellent intermediate term results. The cosmetic incision described provides a normal, wide caliber, slit-like glans. Two-stage procedures provide satisfactory outcomes but they are associated with a higher revision rate.

Barbagli et al reviewed a total of 45 patients with an average age of 45 years who underwent dorsal onlay skin graft urethroplasty between January 1994 and December 2000. Of the patients 23 had undergone an average of 2.6 prior endoscopic procedures (range 1 to 14). Preoperative evaluation include clinical history, physical examination, retrograde and voiding urethrography, and ultrasonography. In all patients the bulbar urethra was opened along its dorsal surface, the graft was sutured, splayed and quilted to the corpora cavernosa, and the urethra was rotated to cover the graft. In all patients was used penile skin as substitution material. Mean graft length was 4.7 cm (range 2.5 to 11). Three weeks after surgery voiding cystourethrography was performed. Average follow-up was 71 months (range 41 to 110). Clinical outcome was considered a failure when postoperative instrumentation was needed, including dilation. Of 45 cases 33 (73%) were classified as successful and 12 (27%) were failures. The 12 failures were treated with internal urethrotomy (1), end-to-end-anastomosis (1), skin graft urethroplasty (2) and 2-stage urethroplasty

(6). Six of the 12 initial failures had a satisfactory final outcome. The remaining 6 patients refused further surgical procedures and received a definitive perineal urethrostomy. They have concluded by saying that penile skin grafts used as a dorsal onlay for bulbar urethral reconstruction in a homogeneous series of patients showed a tendency to deteriorate with time. Longer followup is required to compare penile skin with buccal mucosa as substitute materials for bulbar urethral reconstruction.

Christopher J.Kane has done a retrospective analysis of patients who had undergone buccal onlay urethroplasty at 4 military medical treatment facilities participating in the Uniformed Services Urology Research Group was performed. The database generated included demographic data, genitourinary history, preoperative symptoms (American Urological Association symptom score), preoperative urinary flow rate, stricture length and operative statistics. Postoperative follow-up data included symptom score, flow rate, retrograde urethrogram results, and complications. A total of 53 patients (average age 32 years, range 17 to 64) underwent buccal mucosal graft urethroplasty between January, 1996 and March, 1998 for refractory strictures. Sixteen patients had undergone an average of 2.2 prior endoscopic procedures (range 1 to 7). Average stricture length was 3.6 plus or minus standard deviation

1.8 cm. (range 2 to 7.5) as measured on preoperative retrograde urethrogram. Followup averaged 25 months (range 11 to 40 months). Average symptom scores decreased from 21.2 (range 14 to 33) preoperatively to 5.4 (range 3 to 8) postoperatively (p 0.001). Average peak urinary flow rates increased from 7.9 preoperatively to 30.1 ml. per second postoperatively (p 0.001). Postoperative retrograde urethrograms were available for 34 patients and were normal in 24. The overall complication rate was 5.4%. Three patients required endoscopic incisions. One patient has a recurrent narrowing and treatment is considered a failure. There were 4 sacculations (7.5%) and 6 narrowings, 3 of which required further treatment. Of the patients 50 required no additional procedures (94.3%).

Christophe E. Iselin et al has reviewed 29 men with a mean age of 43 years (range 10 to 81) who underwent dorsal onlay graft urethroplasty. Follow up included retrograde urethrogram at 3 weeks, 3 months and 12 to 18 months, and thereafter when needed. Urinary flow was recorded as subjectively reported by the patients. The technique was used only for bulbar urethral strictures. A total of 23 patients (79%) had undergone previous direct vision urethrotomy and/or open surgery. Dorsal onlay graft urethroplasty was used alone in 12 patients (41%), and was performed with partial stricture excision and ventral strip

anastomosis in 13 (45%). In another 4 patients (14%) the procedure was combined with an Orandi flap because the stricture extended significantly into the penile urethra. Penile skin grafts were used in 27 patients (93%), whereas buccal mucosa was harvested in 2. Mean graft length was 6 cm. (range 3 to 9), and width ranged between 1.5 and 3 cm. Outcome was favorable in 28 patients (97%) for a median follow-up of 19 months (range 10 to 37). One patient had symptomatic proximal stricture recurrence and 3 had radiographic evidence of caliber decrease of the repair but with no impact on urinary flow. They have concluded that dorsal onlay graft urethroplasty is a versatile procedure which may be combined with stricture excision and ventral strip anastomosis or an Orandi flap. Conceptually the technique offers the advantages of spread fixation of the graft on a fixed well vascularized surface, which may improve graft neovascularization, reduce graft shrinkage and avoid sacculation. Although the early outcome is promising, dorsal onlay graft urethroplasty has yet to stand the test of time. Buccal mucosa grafts used as a ventral onlay for bulbar urethral reconstruction yield reproducibly excellent results with minimal morbidity and low complication rates. Longer follow-up will be required to confirm the durability of our results.

Jack. B. Lewis et al reviewed the records of 78, 1-stage anterior urethroplasties performed via excision with primary anastomosis, buccal mucosal graft or penile fasciocutaneous skin flap techniques from September 1997 to December 2000 by a single surgeon (A. F. M.). All patients had more than 1 year of follow-up (range 1 to 4.5). Of the graft procedures only those in the bulbar urethra were included in analysis. Outpatient procedures were defined as those in which the patient was discharged home within 24 hours. Clinical outcome was considered a failure when instrumentation was required postoperatively. Of the 78 anterior urethral repairs 54 (69%) were performed on an outpatient basis, including 50 (93%) in which the outcome was successful compared with 88% (21) of the 24 inpatient procedures. Excision with primary anastomosis had the highest outpatient rate (28 of 31 patients or 90%), followed by penile skin flaps (16 of 25 or 64%) and buccal mucosal grafts (10 of 22 or 45%). Patient characteristics were significantly associated with outpatient procedures, including younger mean age (36 versus 46 years), shorter mean stricture length (3.1 versus 6.6 cm.) and shorter mean operative time (3.2 versus 4.66 hours) (p 0.05). Anterior urethral reconstruction can often be completed safely and effectively on an outpatient basis.

M.Bhandari et al., have reviewed their experience in managing complex anterior urethral strictures with a dorsally/dorsolaterally placed penile/preputial vascularized flap, and to discuss the advantages of this procedure over a traditional ventrally placed flap. 40 patients (mean age 40.5 years) with recurrent strictures of the pendulous and/or bulbar urethra were treated with longitudinal penile/circumpenile flap substitution urethroplasty. Nineteen patients underwent dorsal placement of the flap as an on lay (DO), whereas 21 patients had a ventral onlay (VO). Five patients needed inferior pubectomy to facilitate high proximal placement of the flap. Both groups had statistically similar ages, number of previous interventions, stricture site, length and follow-up. After a median follow-up of 27.5 months, the stricture recurred in three (24%) of the VO and two (11%) of the DO groups ($P>0.05$). One patient in the VO group required surgical closure of the urethral fistula. Flap pseudo-diverticulum and/or sacculation with postvoid dribble occurred in six patients in the VO and none in the DO group ($P=0.01$). Dorsal placement of the pedicled flap is anatomically and functionally more appropriate than the traditional VO placement. DO preputial/penile flap urethroplasty is a versatile procedure and can be applied even for long anterior urethral strictures, including reconstruction of the meatus and high proximal bulbar strictures.

Richard A. Santucci et al reviewed all urethroplasties performed on males older than 64years with at least 6 months of follow up at 4 medical centers. Stricture type varied and included anastomotic urethroplasty (44%), penile fasciocutaneous on lay flap (31%), Johanson urethroplasty(stage 1, 6%, stages 1 and 2, 4%), buccal mucosa grafts (7%), foreskin grafts (6%) and meatoplasty (1%). Stricture recurred in 11 (16%) patients, but was managed with a single direct visual internal urethrotomy or dilation in 5 of 11 patients, yielding a final success rate of 91%.Recurrent strictures were more common after fasciocutaneous flaps (7 of 22 cases, 32%) than end-to-end urethroplasty (2 of 31 cases, 6%, p _0.05). Compared to patients younger than 65 years there were more treatment failures, but this was not statistically significant. Perioperative complications were uncommon. Moderate bladder outlet obstructive symptoms developed in 3patients due to benign prostatic hyperplasia. Notably 6 patients treated previously for postradiation strictures did well without complications Older men tolerate urethroplasty and these data indicate that therapy should not be withheld solely on the basis of age. The potential for impaired flap blood supply in this population is suggested but has not been proven. Benign prostatic hyperplasia must be considered in those patients who have decreased stream after stricture repair.

Mundy etal have concluded that buccal mucosal-free grafts appear to be satisfactory material for urethroplasty when applied as a patch. They are tough, resilient, easy to harvest and easy to handle, and leave no visible donor site scar. They appear to have no particular advantage over genital skin-free grafts or genital skin flaps in terms of cure of the structure but avoid the cosmetic disadvantages of local genital skin. As it is not skin, buccal mucosa is resistant to skin diseases such as balanitis xerotica obliterans and is particularly resistant to infection. In short, buccal mucosa may not necessarily give more satisfactory results for the long-term cure of stricture disease, it has many characteristics to make it the material of choice for patch urethroplasty unless a free graft is contraindicated because of poor vascularity or active infection at the site of the stricture.

Michael L.Gralnick et al have reviewed their experience with 29 patients who underwent augmented roof top anastamotic urethroplasty The stricture was in the bulbar urethra in all cases. Six patients had a completely obliterative stricture. Mean stricture length was 1.5 cm. on retrograde urethrography and the mean excised length was 1.2 cm. In 9 of the 29 patients a roof strip anastomosis was augmented by a ventral on lay and in 20 a floor strip anastomosis was formed with a dorsal on lay. On lays included a pedicled skin flap in 7

cases and a graft in 22. Mean on lay length was 4.5 cm. At a mean follow up of 28 months (range 3 to 126) 27 of the 29 patients (93%) were stricture-free and all those surveyed were satisfied with the procedure.

Norman Dublin et al had reviewed 31 operations. Soon after surgery (the first 48 h), 22 (73%) of the patients had little or no oral pain; 70% and 90% of the patients were able to eat and drink, respectively; 59% complained of numbness and 75% complained of tightness of the mouth. At discharge 6 days after surgery 90% of patients had little or no oral pain and all were able to eat and drink, but 10% had moderate-to-severe oral pain, 39% had oral numbness, and 52% had tightness of the mouth. At the time of interview, 16% of patients had oral numbness (mean duration 13.6 months) and 32% had tightness of the mouth (mean duration 20.9 months). In answer to the question of whether they would have their cheek mucosa harvested again if required, 74% responded ‘yes’, 3% ‘no’, and 23% had mixed feelings. BMG harvesting is a good operation, as most patients were satisfied, but it is not without long-term complications and patients should be adequately informed.

CONCLUSION

1. Buccal mucosal graft has good graft properties for graft survival with minimal donor site morbidity.

2. Dorsal onlay graft is the preferred form of graft placement.

3. Buccal mucosal graft is an ideal substitute for urethra in treating medium length bulbar urethral strictures.

4. Because of less failure rate 11.11% single stage dorsal on lay buccal mucosal graft urethroplasty may be offered as an alternative to staged urethroplasty in case of long urethral strictures.

5. Longer follow up is needed (keeping attrition over a period of time for substitution urethroplasty in mind before coming to definite conclusion).

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MASTER CHART

Sl No	Patient Name and Operative procedure	Age (Years) / regitratin no.	Length of stricture and pericath study	Clinical feauturese	Uroflowmetry				
					Parameters	Preoperative	Immediate post operative	At 3 months	At 6 months follow up
1	Jeganthan Dorsal onlay urethroplasty upto meatus. Graft first fixed to urethra. Blandy's flap urethroplasty.	43 1768/03	12cm. leak (+)	BXO. Meatal stenisis. Spc diversion Circumcised glans.	Peak flow rate Avg. flow rate Voided volume.	SPC	29ml/sec 16 ml/sec 256 ml	8 ml/sec 4 ml/sec 212 ml visual dilatation	16 ml/sec 12 ml/sec 180 ml self urethral dilatation
2	Kanagaraj Classical Barbagli	33 1176/04	6cm. no leak.	Post Inflammatory OIU-1990,1996,2002 Self urethral dilatation Circumcised glans	Peak flow rate Avg. flow rate Voided volume.	11.2 ml/sec 6.3 ml/sec 251 ml	32 ml/sec 22 ml/sec 325 ml	28 ml/sec 18 ml/sec 312 ml	20 ml/sec 14 ml/sec 420 ml
3	Ravichandran Augmentation Roof top Anastamotic Urethroplasty	33 1152/04	2.5cm. no leak.	Difficulty in passing urine 1 year. Circumcised glans Post Inflammatory stricture	Peak flow rate Avg. flow rate Voided volume.	7.6 ml/sec 1.2 ml/sec 124 ml	38 ml/sec 23.2 ml/sec 320 ml	28 ml/sec 20 ml/sec 312	26 ml/sec 18.2 ml/sec 314 ml
4	Munusamy Ventral urethrotomy and dorsal onlay(Asopa's Technique)	50 1822/03	5 cm. no leak.	Post Bni & vasicolithotripsy (Instrument tation) Spc	Peak flow rate Avg. flow rate Voidedvol.	2 ml/ sec 1.5 ml/sec 152 ml	26 ml/sec 18 ml/sec 243 ml	20 ml/sec 16.2ml/sec 242 ml	18 ml/sec 13 ml/sec 324 ml
5	Kanniyappan Dorsal onlay urethroplasty	37 1162/02	14cm no leak. Intravasation into prostatic ducts..	Meatus normal. Oiu 2 times Periodic urethral dilatation. circumcised glans. Post Inflammatory stricture.	Peak flow rate Avg. flow rate Voided volume.	5.3 ml/sec 3.2 ml/sec 124 ml	24 ml/sec 18.2 ml/sec 212 ml	20 ml/sec 14.3 ml/sec 220 ml	18 ml/sec 12 ml/sec 180 ml

6	Tamilvanan. Oiu and dorsal Onlay urethroplasty	22 3240/03	3.5cm not done.	Meatus normal. Oiu 3 times. Post Inflammatory stricture	Peak flow rate Avg. flow rate Voided volume.	7.6 ml/sec 6.0 ml/sec 541.2 ml	26.2 ml/sec 22 ml/sec 312 ml	24 ml/sec 18 ml/sec 298 ml	20ml/sec 16 ml/sec 264 ml
7	Chinnasamy Dorsal onlay urethroplasty till meatus. Bmg sutured to urethra first. Blandy's flap meatoplasty.	52 2172/04	14cm no leak.	Difficulty in voiding 12 months.BXO. circumcised glans. On Spc.	Peak flow rate Avg. flow rate Voided volume.	SPC	24.2 ml/sec 20 ml/sec 312 ml	14 ml/sec 8 ml/sec 329 ml had restrict at 5 months visual dilatation	34 ml/sec 12 ml/sec 364 ml
8	Manavalan Dorsal onlay BMG upto meatus.	49 3100/04	12cm no leak	C/o slow stream,left loin pain and increased frequency 2 months.BXO	Peak flow rate Avg. flow rate Voided volume.	5 ml/sec 3 ml/sec 180 ml	32 ml/sec 22 ml/sec 280 ml	18ml/sec 10 ml/sec 320 ml	11.2 ml/sec 6.0 ml/sec 272 ml aug graft loss visual dilatation
9	Shanmugam Dorsal onlay BMG till meatus. Ventral meatotomy.	32 4045/04	14cm. leak (+)	Circumcised glans. BXO. On Spc	Peak flow rate Avg. flow rate Voided volume.	SPC	29 ml/sec 18 ml/sec 325 ml	22 ml/sec 16 ml/sec 330ml	17 ml/sec 11 ml/sec 327 ml
10	Parvatham Dorsal onlay BMG till meatus. Ventral meatotomy. meatus	26 4427/04	14cm leak(+)	BXO on Spc	Peak flow rate Avg. flow rate Voided volume.	SPC	23 ml/sec 12 ml/sec 314 ml	16 ml/sec 12 ml/sec 314 ml	13 ml/sec 11 ml/sec 652 ml submeatal catch dilated
11	Harikrishnan Dorsal onlay BMG upto meatus.	47 460/05	8.5cm leak (+)	Post inflammatory On Spc	Peak flow rate Avg. flow rate Voided volume.	SPC	41 ml/sec 22 ml/sec 309 ml	23 ml/sec 16 ml/sec 592 ml	15 ml/sec 11 ml/sec 607 ml
12	Ramu Dorsal onlay BMG upto meatus. Ventral meatotomy.	40 852/05	10cm no leak	BXO. On SPC	Peak flow rate Avg. flow rate Voided volume.	SPC	19 ml/sec 13 ml/sec 234 ml	18 ml/sec 14 ml/sec 243 ml	
13	Munusamy Dorsal onlay BMG upto meatus. Ventral meatotomy.	50 2704/05	12cm no leak.	Bxo	Peak flow rate Avg. flow rate Voided volume.	4 ml/sec 3 ml/sec 142 ml	36 ml/sec 24 ml/sec 260 ml		

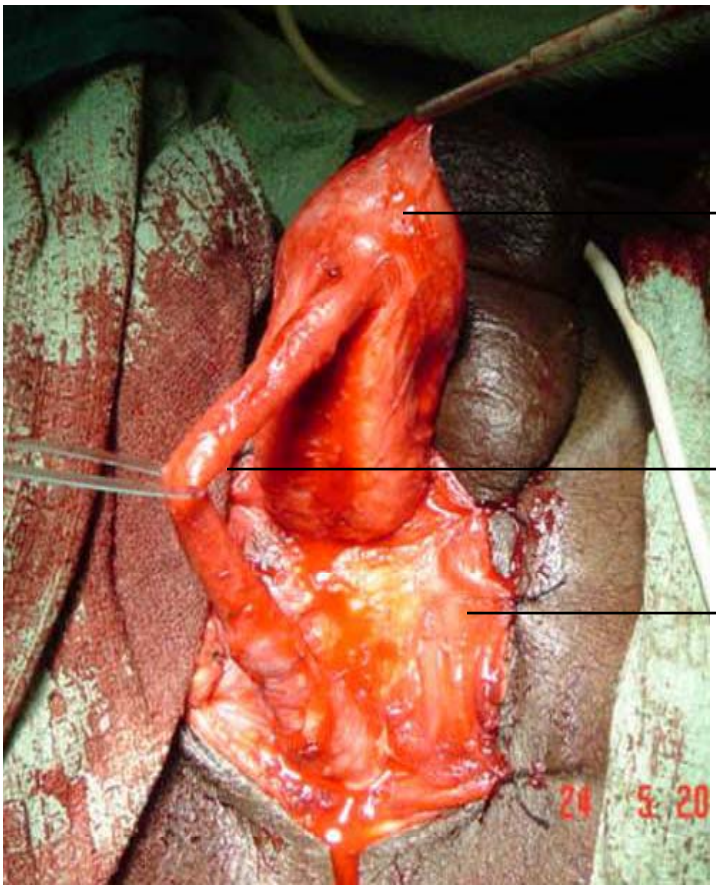
AUG showing panurethral stricture with Beaded appearance

AUG smooth panurethral stricture

BMG harvesting

Perineal incision

Invaginated penis

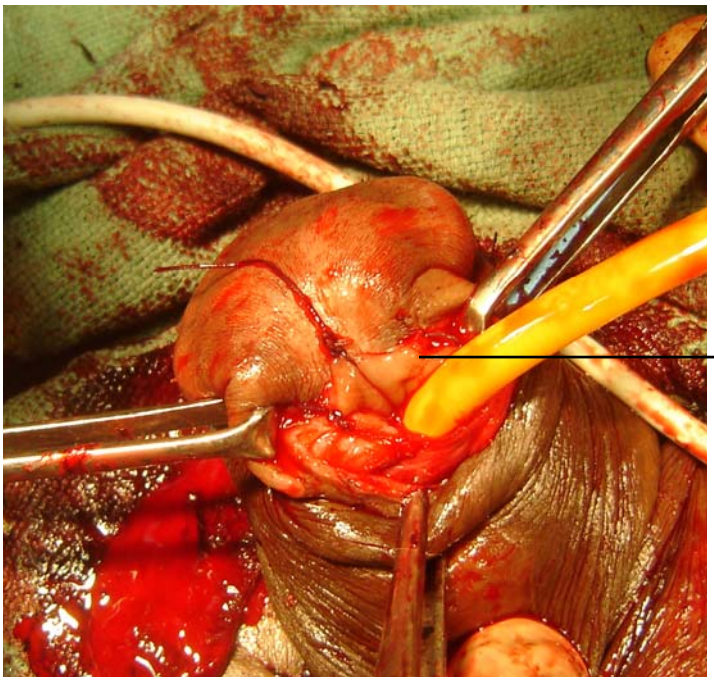


Penis invaginated through the Perineal incision.

Urethra dissected from corporal bodies

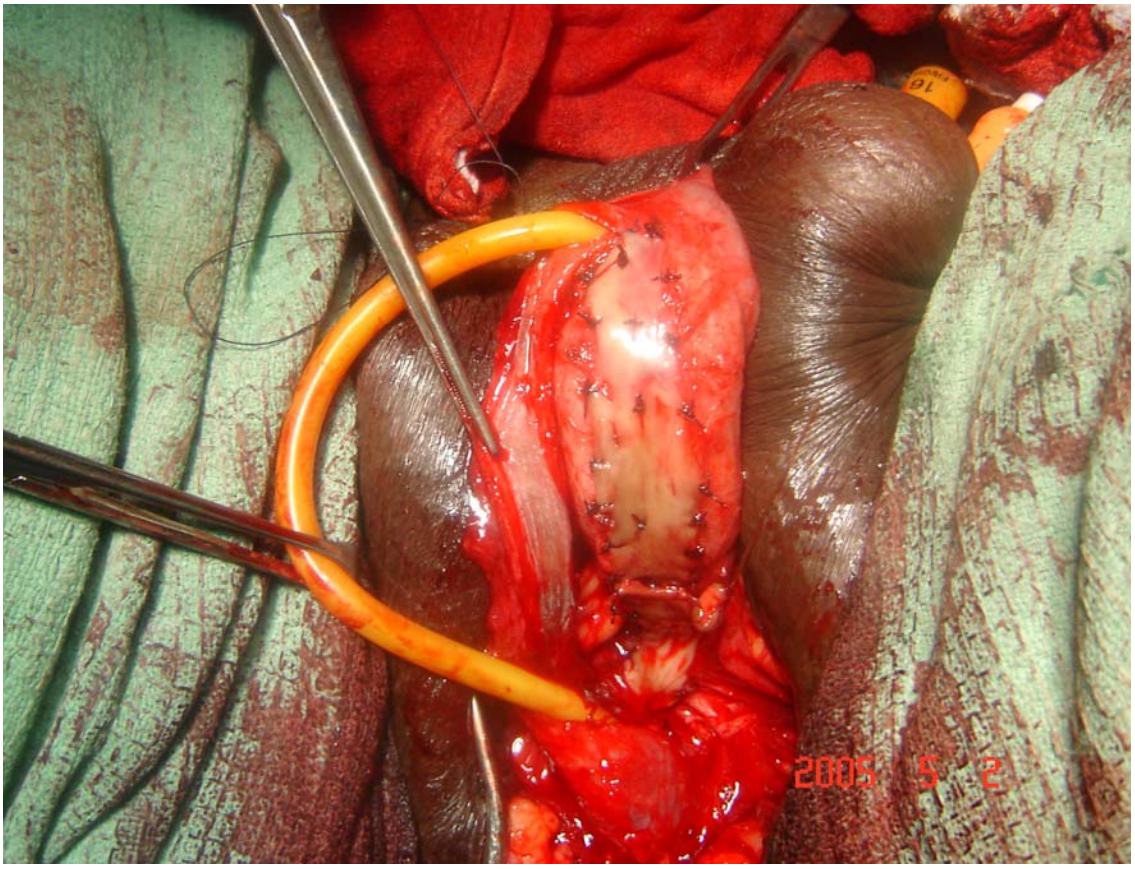
Bulbospongiosus

BMG sutured to the meatus

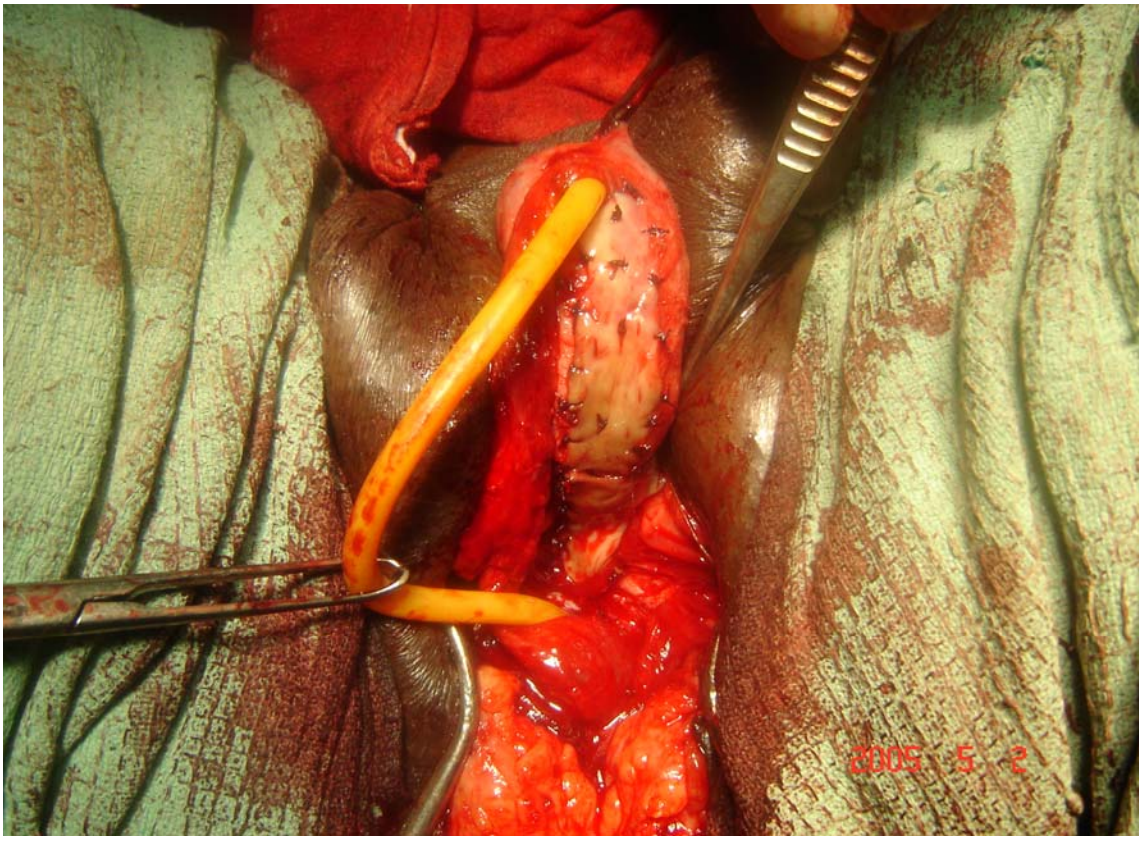


BMG

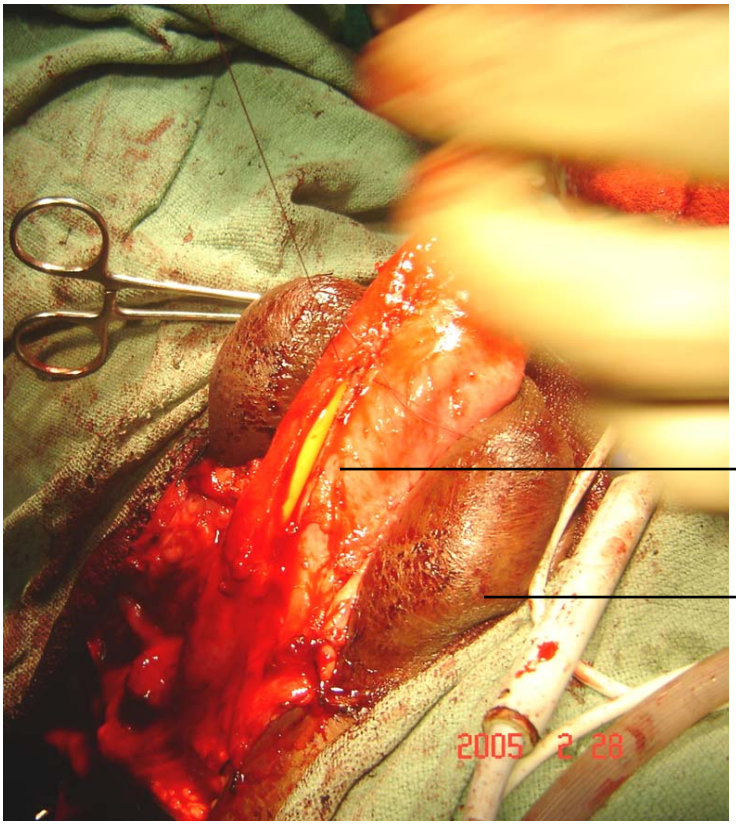
Laid open urethra held with forceps.
BMG sutured to the roof



Two BMG sutured till proximal urethra



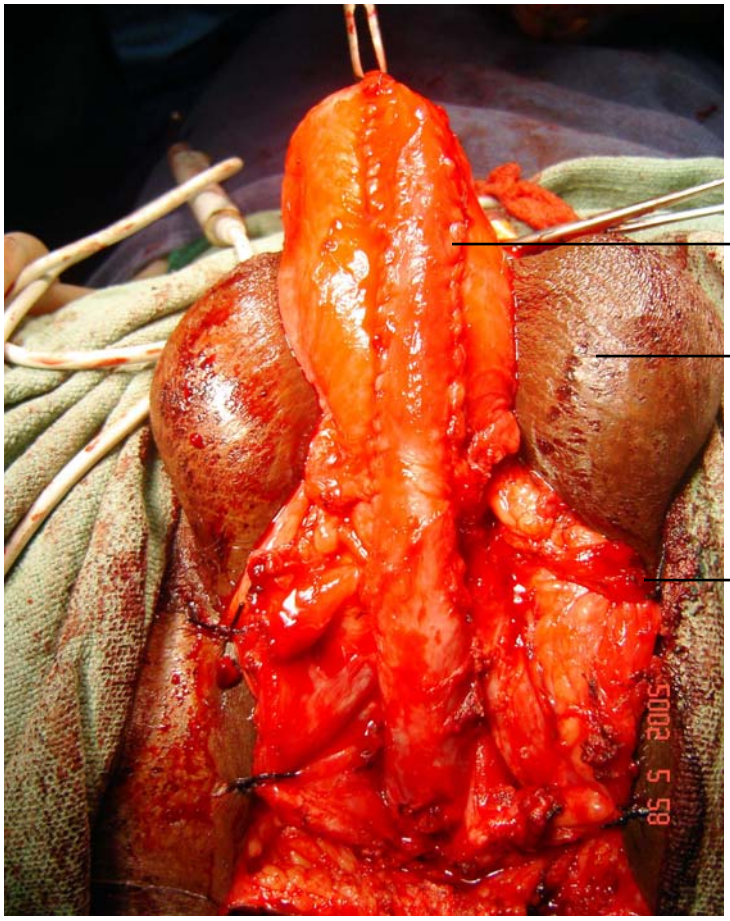
BMG being sutured to left side of urethra



Foley's catheter

Scrotum

Completed urethroplasty

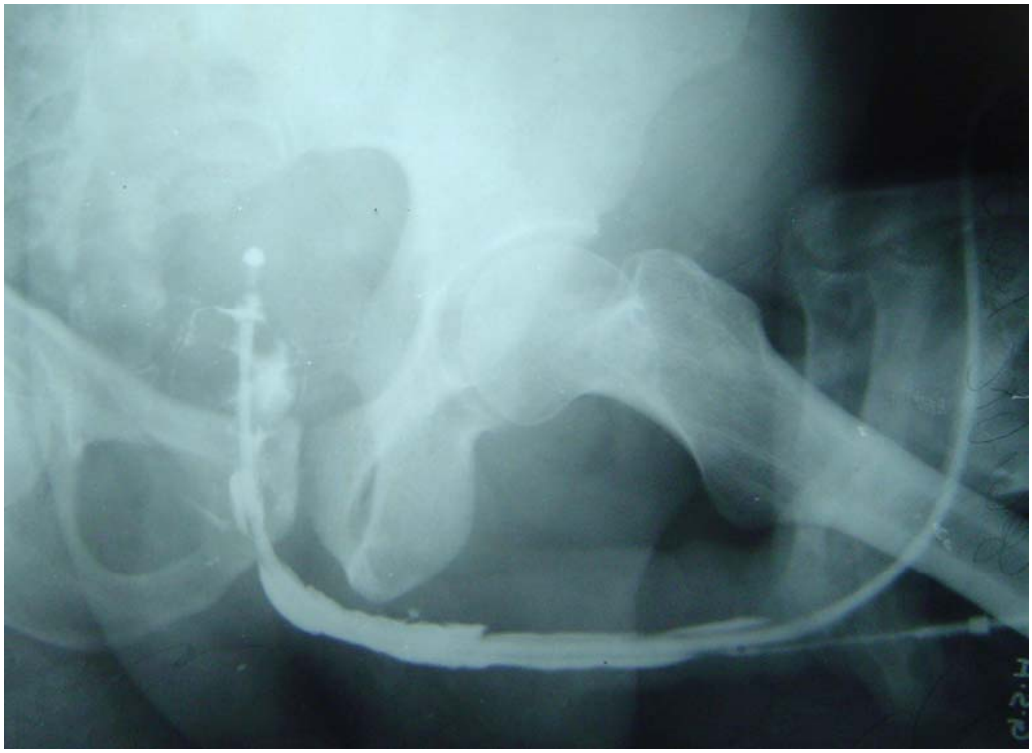


Penile urethra

Scrotum

Bulbo spongiosus muscle

Peri-catheter study - normal

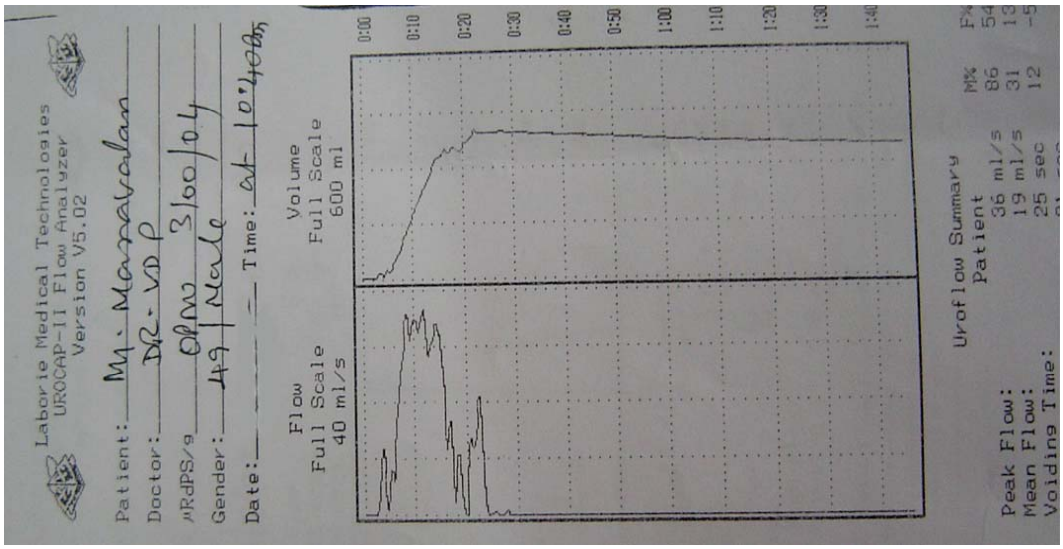


Peri- catheter study showing leak

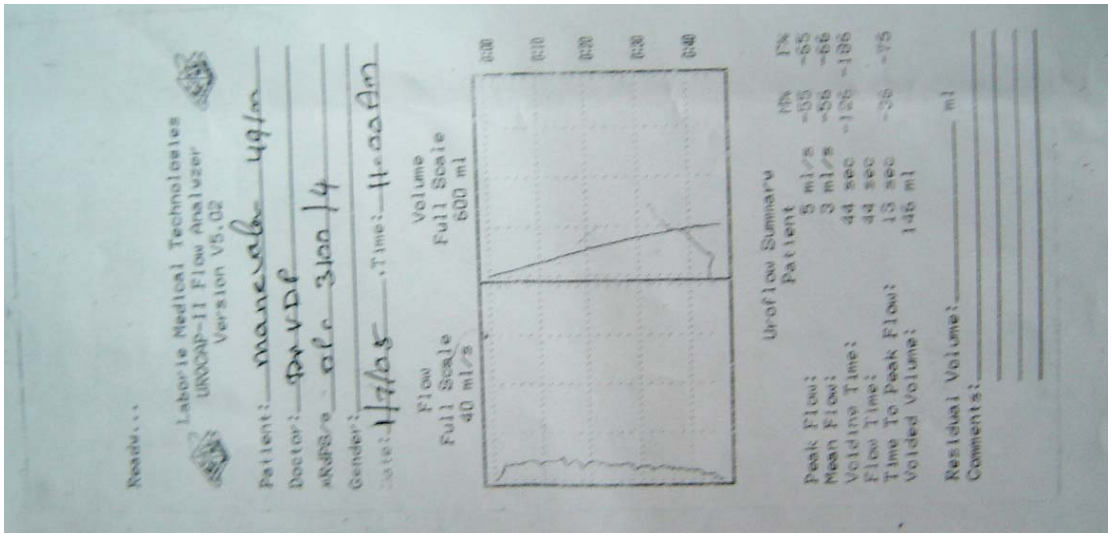
AUG of successful BMG 3 months

AUG of bulbar urethral stricture recurrence

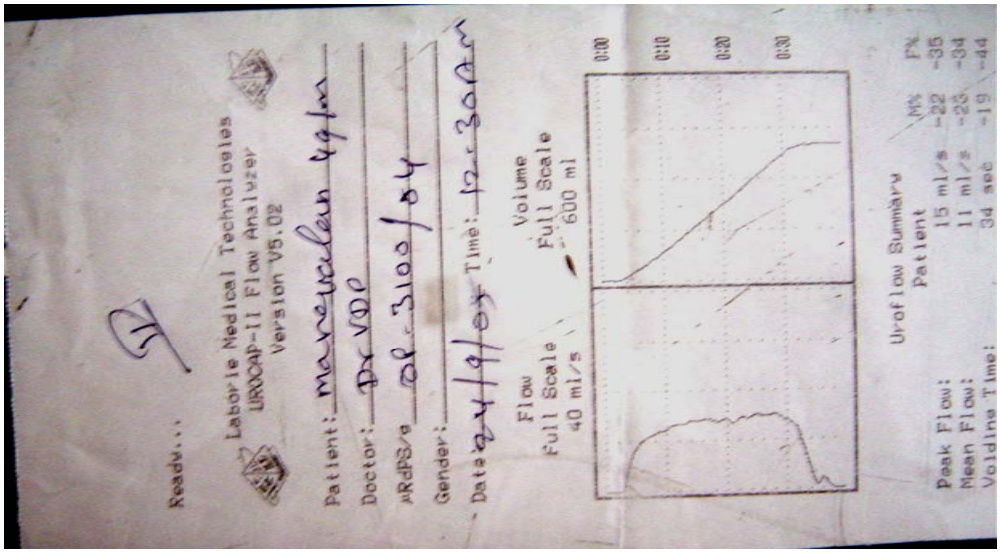
Immediate post op uroflometry



Flow rate at 7 months post op



Flow rate 2 months after visual dilatation



PROFORMA

BUCCCAL MUCOSAL GRAFT URETHROPLASTY

Sl.No.

Name : Age:

Address: Ph. No:

Presenting complaints:

Duration of stricture: Etiology:

H/O Previous urethral instrumentation:
OIU
Self urethral dilatation urethral dilatation (urologist)

AUG:

Uroflow:

Operative notes:

Donor site complications:

Urethroplasty complication:

Followup:

Intervention:

Uroflometry	Peak flow	Avg. flow	Voided vol.

AUG: